Circulation of Marginal and Semi-Enclosed Seas
(Sea of Japan and Related Process Studies)

Christopher N.K. Mooers
Ocean Prediction Experimental Laboratory
Division of Applied Marine Physics
Rosenstiel School of Marine and Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149-1098
Phone: (305) 361-4088 Fax: (305) 361-4797
Email: cmooers@rsmas.miami.edu
Award #: N000149610935
http://www.rsmas.miami.edu/divs/amp.html

LONG-TERM GOAL

My long-term goal is to understand the circulation dynamics of marginal and semi-enclosed seas through numerical simulation. Understanding the weather-driven transient flows (especially in coastal regions), mesoscale variability, ventilation, seasonal and interannual variability, and flow interactions with the basin topography are part of this goal.

OBJECTIVES

I wish to determine the "necessary and sufficient" conditions for usefully accurate numerical simulations, which requires attention to model evaluation using observations as well as other models. For example, the oceanographic community has yet to establish the space-time resolution and amplitude accuracy requirements for atmospheric forcing of marginal and semi-enclosed seas. Given the difficulty of determining, in particular, open (lateral) boundary conditions, it is anticipated that data assimilation will be required.

APPROACH

We are using the Princeton Ocean Model (POM) as implemented on a mesoscale-admitting grid (ca. 10 km. resolution) and with 26 sigma levels (and with relatively high, logarithmic resolution in the surface and bottom boundary layers) for the Japan (East) Sea (JES). It is driven with surface windstress, heat flux, and moisture flux, and with specified throughflow from the Korean/Tsushima Strait to Tsugaru and Soya Straits. The model output is compared to available data, especially CREAMS I current meter data (from Prof. Masaki Takematsu, Kyushu U.) over the Japan Basin. I aim to create and analyze a test dataset by simulating the CREAMS II field experiment in advance of the completion of the fieldwork, and to later conduct model evaluations and data assimilation with the CREAMS II observations.

WORK COMPLETED

Sensitivity studies of forcing and model parameters were conducted.

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Preliminary model runs were made with NSCAT, ECMWF, and MM5 (from Dr. Shuyi Chen, RSMAS) synoptic atmospheric forcing for Siberian cold air outbreaks and their associated atmospheric cyclones.

Groundwork was laid with Profs. Leonid Piterbarg, USC, and Alexander Ostrovski, Kyushu U., for model evaluations, including development of new methodology. Dialogue has been initiated with other JES modelers regarding model-model and model-observations comparisons.

As Co-Chair of PICES Working Group 10, a draft report and modern bibliography were completed; they cover the circulation and ventilation of the JES and adjacent waters.

RESULTS

A series of model sensitivity studies demonstrated the importance of vertical resolution specification and atmospheric and throughflow forcing functions (Kang, 1997).

The slope and intensity of the energy spectra of model output velocity agree well in the mesoscale band with those of CREAMS I current meters at 1,000, 2,000, and 3,000 m over the Japan Basin (see attached figures) with steady forcing; thus, the mesoscale variability is largely due to intrinsic instabilities. However, the mean simulated velocities are too large for unknown reasons, and the observed near-inertial motion is intense (and there are virtually none for model simulations with steady forcing) due to forcing by weather systems, which will require synoptic atmospheric forcing for the model simulations to emulate.

The response to well-resolved (from MMS), intense Siberian cold air outbreaks (and associated atmospheric cyclones) indicates rapid excitation of basin scale modes and localized ventilation to ca. 200 m depth, especially off Vladivostok over the Japan Basin.

IMPACT/APPLICATION

Our results indicate the importance of resolving the mesoscale structure of cold air outbreaks and atmospheric cyclones and monitoring the throughflow.

TRANSITIONS

A copy of our model was transferred to Prof. Ostrovski, RIAM/Kyushu U., for his parallel use and comparisons with observations and other models.

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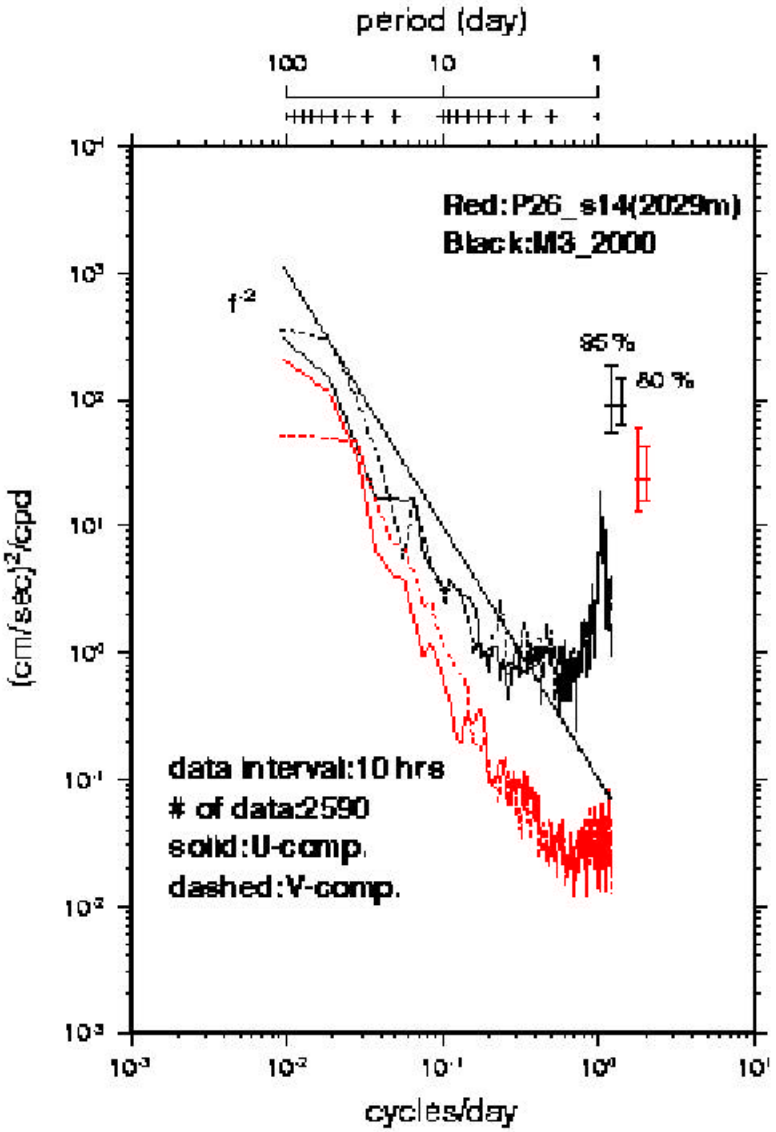
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80 %
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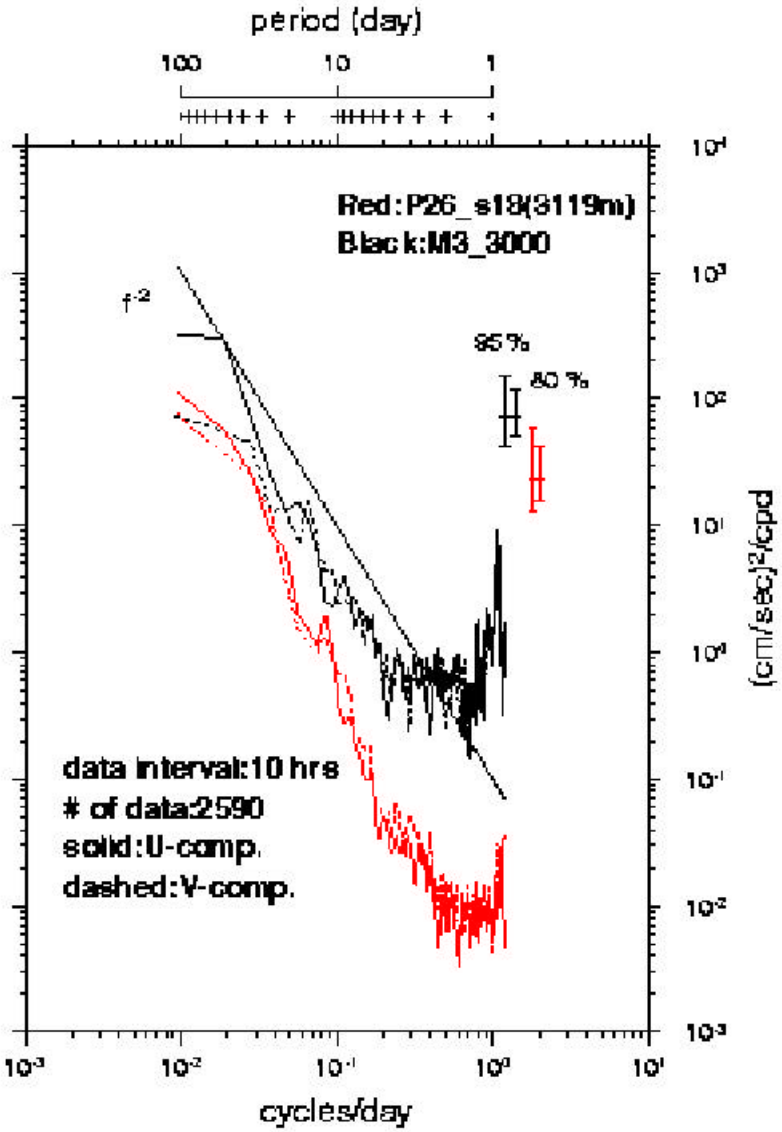
solid:U-comp.
dashed:V-comp.
(cm/sec)2/cpd
cycles/day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95 %
80 %
data interval:10 hrs
# of data:2590
solid:U-comp.
dashed:V-comp.
(cm/sec)2/cpd
cycles/day

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